P Chassis

for MotorHomes

General Information
for Alignment

DRAFT

Introduction

The intent of this document is to provide both reference information and guidance for getting the Chevrolet P Chassis to perform as it was designed to perform.

A majority of the information is taken from the 1995 and 1997 "*Chevrolet Motor Home Chassis Service Guide*" for the P Chassis. However, the information has been presented in what is felt to be a logical sequence to accomplish that most elusive item for this chassis – good handling.

Age is the common enemy of the chassis. It has been around a long time and many of the older motorhomes on this chassis are showing signs of age. The idea here is to simply get appropriate repairs done to bring the chassis back to reasonable condition and then figure out the correct specifications for alignment.

Along the way, you have probably encountered your share of not-so-competent mechanics and/or alignment shops. Matter of fact, many alignment shops simply don't know how to deal with this motorhome version of the P Chassis and wind up treating it like a truck.

We will show you that simply telling the alignment shop that it's a "P30 Chassis" will almost guarantee you an incorrect alignment. Your Class A motorhome is NOT built on a "P30 Chassis". The correct general term is a "Motorhome P Chassis". The P Chassis was also used for what is referred to as a Commercial (Forward Control) truck. The same chassis series has been used for G10, G20, G30, P20, P30, and Motorhomes under a '32 - 52' designation. What's more, the alignment specs are different for the motorhome chassis because they were made slightly different.

If you decide to do some of the repair work yourself, such as replacing bushings, remember that you can generally 'rent' specialty front end tools from your local parts store at a cost of $0.00 when you buy the parts from them. A deposit is all that is generally required. You can probably get some good instructions on safely using the tools too.

Chevrolet had 7 model numbers for the Motor Home P Chassis, only the ones with '-52' were destined for Class A motorhomes. Class C motorhomes were also built on some of the Commercial truck chassis.

P30832	125" wheelbase
P31132 - 52	137" wheelbase
P31432 - 52	159" wheelbase
P31832 - 52	178" wheelbase
P31932 - 52	190" wheelbase (Start-up production in 1991) (19.5" wheels)
P32032 - 52	208" wheelbase (Start-up production in 1988) (19.5" wheels)
P32132 - 52	228" wheelbase

The Motorhome Chassis also has different frame rails. Be careful to NOT use adjustment/maintenance information from a Forward Control Chassis manual for your Class A motorhome. Some things are common, some things are not.

It is unfortunate that even GM's documentation varies in what it names these chassis. The "P30" term is simply too generic to help when specifics are needed.

If the 5th thru 7th positions in your VIN number are "P37", then you have the motorhome version of the chassis. Actually, it is the '7' that tells us we have the motorhome version of the chassis. (See Appendix C for the VIN breakdown.)

But, not to get too far ahead of the process we will describe on the following pages.

Stay with it and I think you will come out happy in the end.

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The Process

The first step to maintaining proper vehicle handling is through the regular inspection and replacement of suspension bushings, ball joints, tie rod ends and just about everything else that makes up the front and rear end suspensions of the motorhome.

The second step is to perform a suspension alignment. Sounds straightforward enough, but the P Chassis has been given a reputation for not handling very well, even after an alignment has been done. The catch seems to be that many of the motorhomes experiencing drivability problems have old, worn, saggy parts. Sound familiar? Not only that, but there doesn't seem to be a lot of expertise out there in alignment shops for this chassis. In other words, you have to take the ball in your own hands and verify everything is checked and in good shape BEFORE an alignment is performed, even to the point where YOU supply the alignment specs to the alignment shop.

Let's go through the process in a step-by-step manner.

Worn Parts

Make sure that worn parts are replaced, everything is tight, everything is there and a proper lube job has been done. What worn parts?

1. Ball joints
2. Tie rod ends
3. Steering relay rods
4. Damper (that horizontal shock)
5. Steering gear
6. Shock absorbers
7. Loose control arms
8. Loose or missing stabilizer bar attachments
9. Front wheel bearings
10. Bushings, including those on the torsion bars – front and rear.
11. Air bags properly inflated
12. Spring problems

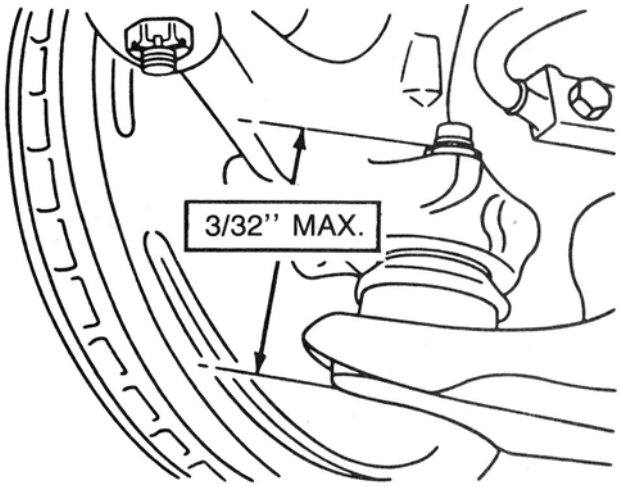
Some details:

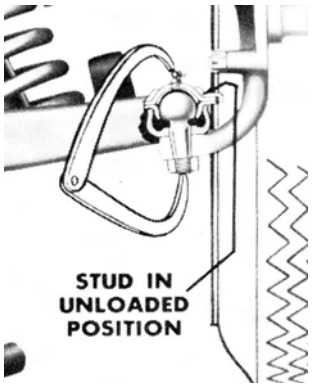
Before you attempt to crawl under the front end for inspection, it might be worthwhile to take a trip to the local car wash where you can use a high pressure spray to knock off the gunk. Steam cleaning, solvent and elbow grease are alternatives. Don't forget goggles to protect your eyes and wear junky clothes. Don't point that high-pressure spray directly on the air bags and any

hoses or the bottom of the radiator. You can drill right through, just like you can drill through your own hand if you point it incorrectly. Don't forget to clean the rear axle housing too.

Proper lube of ball joints means lifting the motorhome by a frame member so the suspension hangs free and then lube the zerks. Don't forget to wipe the zerks clean before you lube. Otherwise, you will be pushing gritty dirt into the joint. If the motorhome is lifted for lubrication by driving up on wheel ramps, the ball joints are under enough tension to inhibit full flow around the entire ball socket. Also, when lifted like this, it is a good time to check ball joint wear.

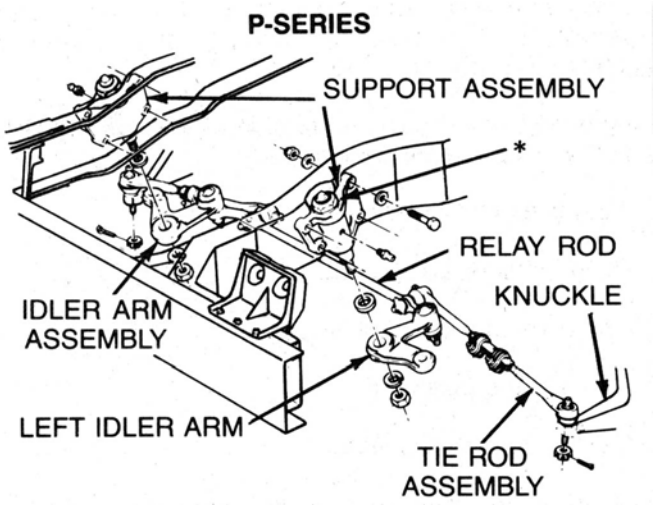
To do this you will need a caliper that will measure the lower ball joint distance between the tip of the ball stud and tip of the grease fitting below the ball joint while the suspension hangs free. Then, change the point you are lifting the front end so that you are supporting the weight of the control arms at each wheel or each lower control arm. Again measure between the same points on each lower ball joint. The difference between the two measurements for each should not exceed 3/32 of an inch. Remember, even new ball joints have play in them. If they didn't, they wouldn't move. If you replace, replace in pairs.





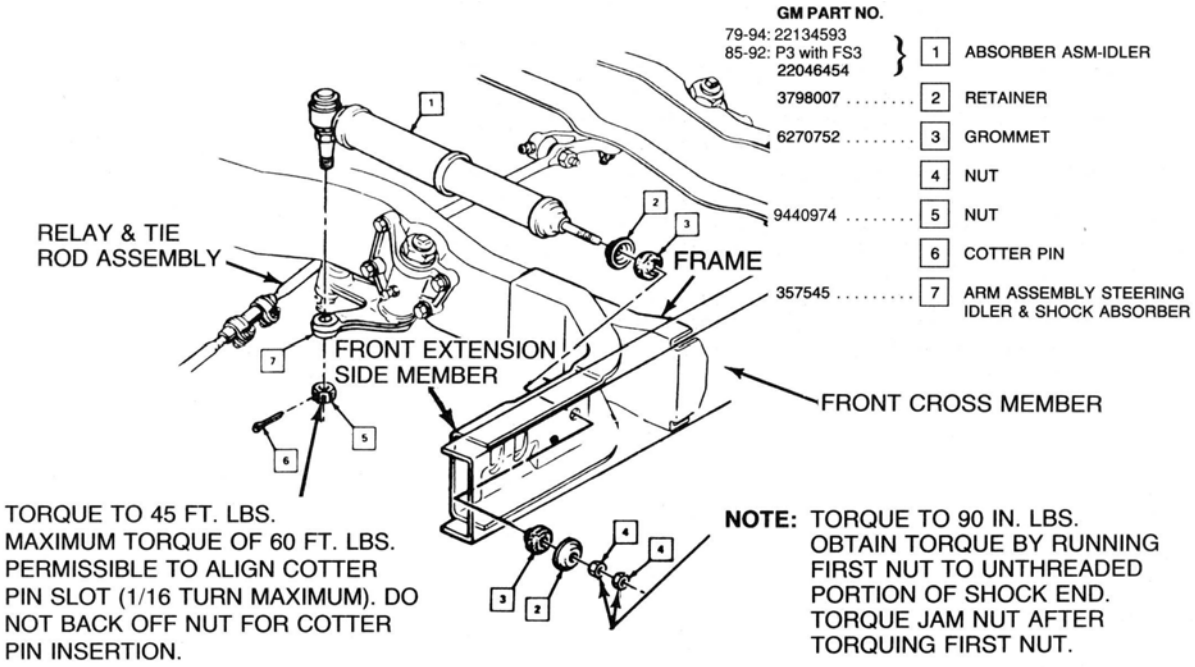
Look at all the rubber washers and bushings for cracks, bulges and wear. The upper and lower control arm bushings get pretty bad after 10-20 years. These are cheap to buy and labor is the real price. If you can replace them yourself, do it. Also, using a spray-on rubber lube on suspension points on a regular basis is cheap insurance – once you know they are in good shape.

The steering linkage is located forward of the front cross member. The P Chassis linkage is illustrated below. Steering effort is transmitted to left- and right-hand adjustable tie rods through a relay rod. The relay rod is connected to an idler arm on the right and to the pitman arm on the left. The fit of the shafts in the linkage support assemblies should be tight with end play not exceeding .003. If it exceeds .003 inches in either assembly, adjust to within 0 to .003 inches. Set large lock nut torque cap to 25 ft. lbs. and then loosen 1/16 turn and tighten lock nut. If there is side play, replace the bushings. Lube the linkage under 'normal' conditions every 7,500 miles or every 3,000 miles if used in 'dusty' conditions. The "support assembly" in the illustration below is also known as a "bellcrank".



Many motorhomes sit in storage for a long time between use. That steering damper (it's really a shock absorber) can accumulate rust on its horizontal exposed rod. If it does get heavily rusted and you just jump in after a long storage period and drive off, that rusty rod may rip up the seal as soon as it moves inward. Good idea to check it and possibly clean it off. Turn the steering wheel so as to extend the rod fully while you check it. If it's badly rusted, it's probably a good idea to replace the damper. Same thing applies to the shocks. Think about some preventive measures added to your pre-storage checklist to help prevent this situation. Check the damper attachments to make sure they are tight. Rubber bushings should be replaced if they are worn, cracked or crushed. Check for leaks or noisy operation(it's a shock absorber). In 1991 the GM

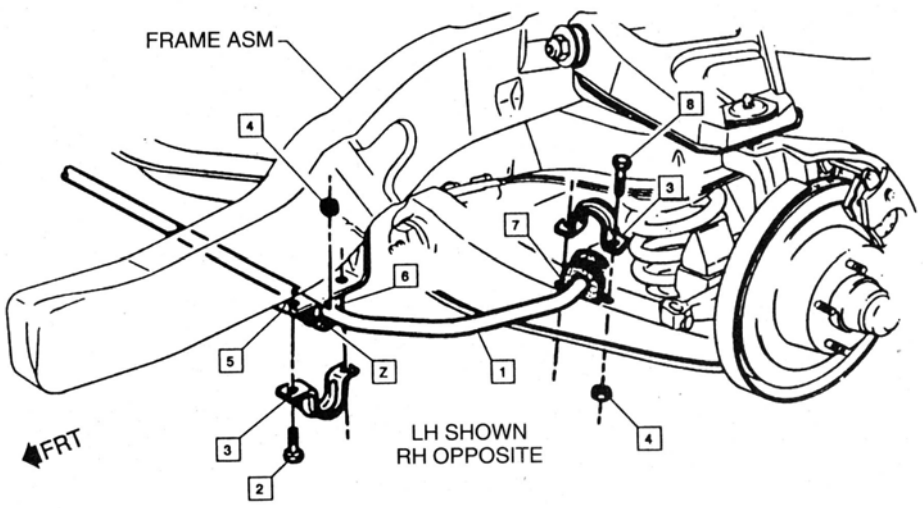
part number of the damper changed to 22011982.



The steering is a recirculating ball type and needs basic checks for fluid level and condition (ever think of changing that fluid?), drive belt tension, loose mountings, and loose pump pulley. If the power steering pump needs to be replaced, be aware that the motorhome version is different from the standard Commercial P-Series version. It is a stronger pump with higher pressure ratings. The wrong one will definitely affect steering effort.

Shocks are generally checked for leaks, bad bushings or damage from getting hit by road junk and being bent. However, if you are chasing down bad handling, a worthwhile step is to disconnect the lower part of each shock and find out if it really has resistance to movement, both up and down. You might be surprised. Always replace in pairs. Don't forget to look at the mounts for breaks or broken welds. Replacing with a stronger rear shock may require reinforcement to the rear mounts. Instructions should be with the shocks, but will require some welding.

The front stabilizer bar (see below) has 4 rubber bushings, one at each end and two on frame mounts. Make sure those mounts are tight and all the bushings are in good shape.



The front wheel bearings require lube every 12,000 miles with high-temperature grease – really. Check the bearings by raising the motorhome and supporting it at the front lower control arm on each side. Now you can spin the wheel and check for noise or roughness. To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. If hub assembly movement is less than .001 inch (too tight) or more than .005 inch (too loose), adjustment is needed.

The adjustments steps are:

1. Remove the hub cap or wheel disc from the wheel.
2. Remove the dust cap from the hub.
3. Remove the cotter pin from the spindle and spindle nut.
4. Tighten the spindle nut to 12 ft. lbs. while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease which could cause excessive wheel bearing play later.
5. Back off the nut to the "just loose" position.
6. Hand tighten the spindle nut. Loosen the spindle nut until either hole in the spindle lines up with a slot in the nut (not more than ½ flat).
7. Install the new cotter pin. Bend the ends of the cotter pin against the nut. Cut off the extra length to ensure that the ends will not interfere with the dust cap.
8. Measure the looseness in the hub assembly. There will be from .001 to .005 inch end play when properly adjusted.
9. Install the dust cap on the hub.
10. Replace the wheel cover & hub cap.

Doesn't sound like something you can easily determine? Take it to a shop you trust.

Air Bags

Air bags are an interesting item to folks with this chassis. Leaks can be located by removing the bag from the vehicle, inflating it and submerging it – just like looking for a tire leak. Actually, if it doesn't hold pressure, you have a leak. The logical repair is a replacement. If you replace, replace bags as a pair.

There are basic guidelines for inflation depending on which version of the P Chassis you have. The air pressure should never be under 10 PSI unless you are removing/replacing the airbag.

Air Bags Front:

For a 4,300-lb suspension, 40-50 PSI.
For a 5,000-lb suspension, 50 PSI.
For a 5,300-lb suspension, 70 PSI.
For a 5,500-lb suspension, 90 PSI.

The GM part number is 367762 for the bags used in the 4,300 and 5,000-lb suspensions.
The GM part number is 15631881 for the bags used in the 5,300 and 5,500-lb suspensions. This is an Airlift H.D. Bag. The part numbers can be updated at any time, and a new part number of 15731951 was released for 1984 through 1997, but your handy GM dealer should be able to figure it out. Be aware that these front air bags are contributors to the GAWR (Gross Axle Weight Rating) for the chassis. Underinflation actually will decrease the rating and will undoubtedly affect handling. Overinflation makes the ride harder and doesn't increase the rating.

REAR:

I've seen air bags on the rear of a Winnebago Warrior ... but don't know if these were installed by Winnebago or a previous owner. These seem to be installed by after-market suppliers to cure sagging rear spring problems. There is no reason to believe they can be used in the rear to cure overweight problems unless other items in the rear suspension are also beefed up. I can find no reference in the P Chassis manuals that say they are installed by Chevrolet. Tag axles added by a coach manufacturer sometimes use air bags instead of springs. You have to get the inflation spec from the manufacturer. Except for the tag axles, if the class A you just purchased has rear air bags, chances are they were installed as an after-market fix by a previous owner. The good objective for having them would be for the empty coach to sit level with almost empty rear air bags, and then inflate to compensate for various loading configurations up to whatever max the airbag manufacturer has specified.

If you are inflating any airbags to compensate for out-of-level problems, it might be worthwhile to consider replacing the coil springs in front and/or getting new or re-arched springs for the rear. Think in terms of the age of your motorhome. Springs do have a limit to their life. The

'ride height' check we will do in a bit and the charts in Appendix A and B will help with this determination.

Weight

Wait a second. Before you start throwing new springs, bags, etc. at the motorhome, have you checked its weight? You're looking for the GAWR. At a minimum, you should be able to find the label that gives the rating for your motorhome for the front and the rear axle. Front 4,300 lbs. and rear 7,500 lbs. is a common combination for a short chassis motorhome with a 137 inch wheelbase. Add them up and you come up with the GVWR (Gross Vehicle Weight Rating) of 11,800 lbs for our example.

That 4,300 lbs. for the front means that each tire is expected to carry 2,150 lbs. In other words, the front is expected to be balanced side to side. Same goes for the rear. 7,500 lbs. means that each dual pair of tires is expected to carry 3,750 lbs. (that's 1,875 lbs. per tire). This means these are the MAXIMUM weights at each corner of the motorhome. It was designed for these weights. You can't simply put on a 'better' tire or overinflate the tire or airbags to compensate for higher weight at one corner. Could be that the wheel bearings, springs or the axle are the limiting factor and you might crunch something if you exceed a corner weight.

Anyway, get it weighed. Preferably each corner separately. You might check with your local state police and find out if they will help. They stop large trucks on the highway and conduct random weight checks – so they have the equipment and may be willing to help you since you are pursuing a safety aspect of driving your coach.

Once weighed, you may find your handling problem real quick. First, you cannot exceed the maximum for the corner. Second, you really want to be balanced side-to-side on each axle for best handling. Move stuff around until you can achieve this. Incidentally, weigh with the same maximum configuration that duplicates how you travel. Full fuel tank, full fresh water. If you travel with much in the holding tanks, you should also take that into consideration and try to duplicate it – maybe even fill them up too. Load up with all the clothes, tools, passengers, etc. that you normally carry. Make sure you are in the driver's seat or a representative amount of weight has been placed there. You're not going to be graded on this by anyone but yourself (well, maybe your spouse). You may find you have to change some habits and dump tanks more often, carry less goodies, carry less water, lose some weight.....

At this point, worn parts are taken care of and the motorhome is within weight parameters. We are almost ready to head to the alignment shop.

Almost.

How about those tires?

Tires

No brand or type tire recommendation is presented here. However, the first rule is that you do not mix different types of tires on the vehicle such as radial, bias and bias-belted tires except in emergencies. Good option is that all tires on an axle are the same brand, type of tread and same age. A 'highway' version for the front and a 'traction' version for the back is OK. Current recommendation is to replace any tire that is 5 to 6 years old. Unless you drive the motorhome quite a bit, chances are they will have 70-80% of the tread still left on them after 5 or 6 years. Check around – especially with your local tire dealers. You might find someone that puts on a lot of miles on a light truck that will buy your old tires. They will use them up in a matter of months, before they really get too old, and you can sometimes get up to half the price of the new ones. Win-win for both of you.

The next rule is that the tire is of adequate capacity for the load it is required to carry and you keep it inflated accordingly.

That previous front suspension example (4,300 lbs. front and 7,500 lbs. rear) for GAWR indicated each front tire had to be able to carry 2,150 lbs. Each pair for the back have to be able to carry 3750 lbs. or 1875 lbs. per tire. I added a sample chart from the P Chassis manual below for this example. (Note the Load Range tire designation under each PSI reading.)

7.50-16 Bias Ply

PSI	30 C,D, E	35 C,D, E	40 C,D, E	45 C,D, E	50 D,E	55 D,E	60 D,E	65 E	70 E	75 E
Lbs per tire- Single	1620	1770	1930	2060	2190	2310	2440	2560	2670	2780
Lbs per tire- Duals	1430	1565	1690	1815	1930	2040	2140	2245	2345	2440

Looks like 50 PSI would be a good choice for both the front and rear tires in the chart above. The placard for this particular motorhome said 60 PSI. This is probably because of the accepted rule to add 5 – 10 PSI if you intend to hit 65mph or better and also to help cover a bit of loss between air checks. A Load Range D or E tire will do the trick if you never cold inflate over 60 lbs. If you think you need 65 lbs., A Load Range E tire would be required.

Looks like 50 PSI would be a good choice for the radial tire in the chart below from Michelin. Bumping by 5 – 10 PSI will get you to 60 PSI for the same reasons noted above. Note that this chart says "per position". That means the left rear, right rear, left front or right front. That also means that the capacity listed for the rear duals is for a PAIR of tires.

These Radial tires are maximum rated for 3,042 lbs. each – when inflated to 80 PSI. That doesn't mean you can put 80 PSI in each tire and increase the capacity for the axle. Nor should you just inflate to the max without a reason. Overinflation is almost as bad as underinflation for handling. All you are really doing is adding too much air, making the ride harder, and messing up the handling. Do it right. There is an optimum pressure for your tires, giving the highest possible grip. Any pressure over this will bulge the tread in the center causing a loss of traction because there is less rubber in contact with the road, and any pressure under this will cause excess distortion of the tire and a loss of traction.

LT235/85R16 LRE

PSI	35	40	45	50	55	60	65	70	75	80
Lbs per position-Single	1700	1870	2030	2205	2335	2485	2623	2765	2905	3042
Lbs per position-Duals	3090	3400	3690	4015	4250	4520	4765	5030	5290	5556

One more thing. Use the size tire recommended by the manufacturer. This is especially important to ensure the tires match the rim's capacity, fit in the wheel well, and in the case of duals, are properly spaced from each other. If the duals touch sidewalls, they won't last and are a hazard. (If you do decide on bigger or wider tires, work with a pro. Substituting LT235/85R16 tires in place of 7.50-16 tires is probably not going to work in the duals position without changing rims too – they would be too close together.) By the way, a bent rim can cause problems, but should be caught when you have the tires balanced.

Current load and inflation information for popular auto tire sizes may be obtained from your local tire dealer, or tables may be obtained free by sending a stamped, self-addressed business-size envelope to "Tables," Tire Industry Safety Council, Box 1801, Washington, D.C. 20013. See the Appendices in this document for an extract from the P Chassis manual with inflation info. The chart for tire inflation in one of the appendices is from the service manual and is not current (it was published in 1995). It is provided as a general guideline – but exact inflation pressures should be obtained from your tire manufacturer for your brand and model of tire.

Don't forget to torque the wheels correctly:

8-bolt wheels (9/16 bolts) get 140 ft. lbs.
5-bolt front wheels and 10-bolt rear wheels get 180 ft. lbs.

We're still not quite ready for that alignment.

There are two more items to check. Ride height and frame angle. Both affect the caster that will be set during the alignment. Without these numbers, you CANNOT come up with a valid CASTER setting.

Ride Height

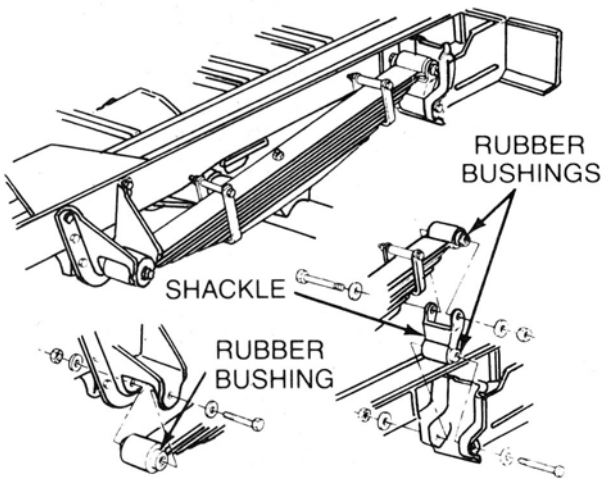
Ride height is checked at four points. Tolerance for manufacture of the springs is ± ½ inch. If the side-to-side measurements are not equal, within the tolerance, some work needs to be done. Also, the front-to-rear ratio for each side should be close to the same. However, there are steps that can be taken to fix or correct these measurements quite a bit.

Ride height measurement points are specified by the manufacturer. On some vehicles, it is from the frame to the ground, a specific point on the underside of the body to ground, or between components as specified by the manufacturer.

The measurement for the P Chassis is taken as illustrated in the next diagrams. The best circumstance is to disconnect one end of each shock absorber before making this check (good time to check the shocks too) and the motorhome must be on an absolutely level surface. If the surface is not perfectly level, you can shim to level by placing squares of plywood under each wheel until the tops of the plywood at each corner are at the same level height. Another option is to take the measurements, mark the position of each corner tire and turn the motorhome around 180 degrees, park in the same marks facing the opposite direction and check the four points again. An average of each reading should bring you close to actual. Of course, you need to start this with an almost-level location. This won't work very well if you do it on the side of a hill.

REAR:

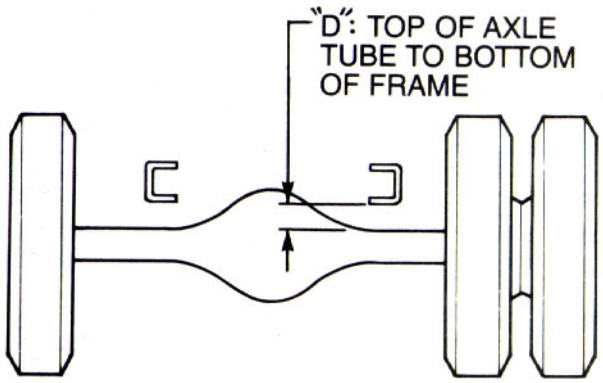
The reason the rear ride height is important to us is because it can affect the handling. Basically, the measurements should be the same side-to-side, just as the front. Before doing anything, check the rubber bushings on the springs and shackles. Look for broken spring leaves – evidence of a crack in the side of a leaf may be the only visible evidence without complete disassembly of the springs. Also make sure there are no obvious broken mounts. The U-bolts should be tight and not broken. Take a close look at the welds where the shackles are attached to the frame and the shackles themselves. If one of these is broken or loose, you will have handling problems. (You already checked the shocks and their mounts and bushings, right?)



One last item to check before attempting to measure the ride height. You are looking for a bent rear axle housing. Indications are found by noticing the inner dual tires wear more than the outer ones. Also look for grease lube leaks at the bottom of the axle housing at the differential. A split gasket near the bottom area almost always indicates an overload, or flex and housing distortion, which destroys the gasket between the carrier and the housing. Failed rear wheel bearings may be another possible indication to prompt a check for a bent axle housing. They can also fail because of a lack of rear differential lube. (You didn't forget to check this during the last lube did you?) A couple of potholes at high speed on a heavily-loaded motorhome can do the trick. However, if the previous owner of the motorhome took care of these leaks and replaced bearings, it is difficult to spot a bent housing except for inner tire wear.

Also, since the wheel bearings are supplied with lube from the differential, make sure that it is full to the appropriate level and changed on a regular basis. All lubricants lose effectiveness over time. Every four oil changes ('normal' or 'dusty' cycle) will do the job. The differential can run a temperature approximately 100 degrees above the ambient temperature. Air passing over the housing is the only thing that carries away this heat. Make sure the housing is not severely covered with dirt or dried mud which will insulate and help retain and increase the heat. (Go back to the car wash and hit the housing with the high-pressure spray.) The exhaust pipe shouldn't be too near the housing. Don't mix lubricant brands – this can cause foaming and reduce heat transfer. If you run at high speeds, it can cause aeration and heat transfer capability will be diminished.

Ride height for the P Chassis rear is checked on each side between the top of the axle tube and the bottom of the frame above the axle tube. You are looking for this "D" measurement to be equal side-to-side. If these are not equal, your weight side-to-side may be unequal or springs may be sagging. In any case, an attempt should be made to get these as equal as possible. Check Appendix B for information on the rear spring capacities for various P Chassis models. (The illustration has a single on the left and a dual on the right because it applies to either situation including non-motorhome versions of the P Chassis.)



Here is a case study right out of the Chevy P Chassis manual:

"GM CASE STUDY: A motor home was loaded to a maximum GVW, both front and rear. Sufficient air was applied to a typical after-market leveling device to establish a 'dead-level' frame. In this case study, wheel travel was limited to ¾ inch before the after-market device "went solid metal-to-metal" between the rear axle and the frame. This severe limitation on wheel travel promoted a "crash-through situation" on even the slightest bump. The force from this "crash-through situation" was transmitted into the vehicle frame, rear axle and the coach itself. GM has determined that these types of after-market leveling devices can be very damaging to the motor home and also can affect vehicle handling and are therefore potentially very dangerous.

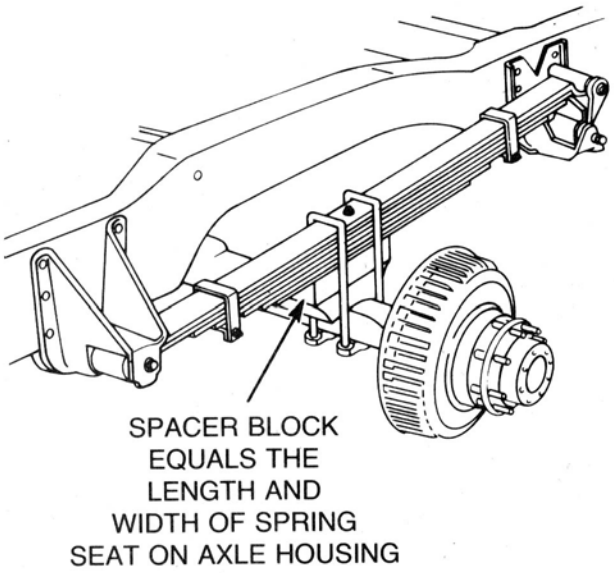
"If vehicle weights cannot be shifted due to vehicle build, consideration should be given to adding spring leaves or spacer blocks."

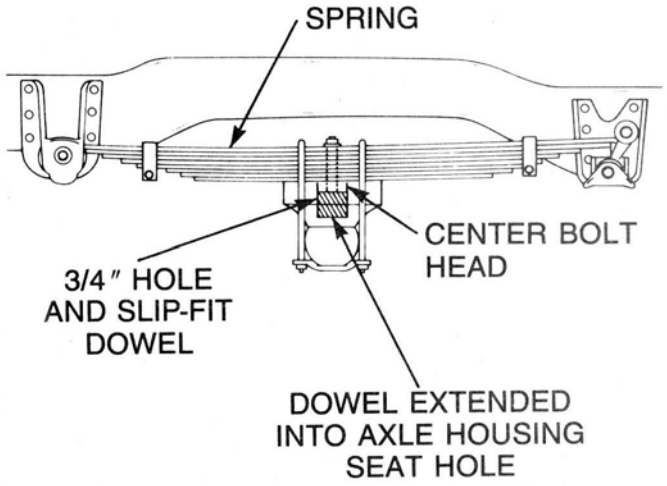
The spacer blocks mentioned above refer to making the side-to-side rear ride height measurement equal. (This supposes that the weight is not in excess of the axle rating and you have moved your moveable stuff around to help balance the side-to-side weight.) Spacer blocks are fabricated in local machine shops.

NOTE: The addition of a spacer block (2 ½" wide, 6" long, thickness as needed) can actually improve overall ride quality while the addition of a leaf tends to reduce the ride quality of the vehicle.

The thickness of the spacer block is determined by the difference in the side-to-side measurements at the rear axle. Once the thickness is determined and the block fabricated, a ¾ inch hole is drilled in the center. A slip-fit dowel, as long as the thickness of the spacer block, is inserted into the hole of the block. This keeps the center of the axle and the existing spring properly aligned. The U-bolts will need to be replaced with longer ones if the spacer block is more than ¾" thick. Also, the rear flexible brake hose that runs from the frame to the axle may need to be lengthened since you are increasing the distance from its mount on the frame to the connection on the axle. Check by slowly lifting the rear by the frame and allow the rear axle to

hang loose. Be careful to check while doing this so you don't accidentally rip up that brake hose in case it is too short.



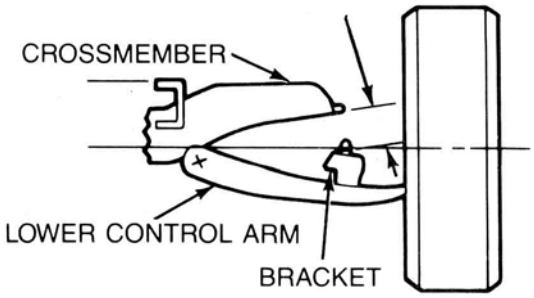


Modifying the rear side-to-side measurements will affect the front side-to-side measurements to some extent. Once complete with the work in the rear, re-check the front. If you 'twist' the rear, the front will be affected.

FRONT:

Coil springs sometimes break near the end and wedge in place without obvious indication of the failure. Look hard. If you think this might have happened, the only way to prove it is to remove the spring.

In the front, the measurement is checked on each side between the lower control arm rubber bumper bracket and cross member flange. This measurement must be perpendicular to the cross member flange. It is from "iron to iron". The rubber bumper is ignored. Look at the illustration below.



Key here is that both sides of the front axle should be the same, and this measurement is used in the CASTER determination. The front air bags should be inflated to the recommended pressure for your chassis. Don't attempt to raise or lower the chassis measurements using the air bags. (If your motorhome has air bags that have been added to the rear to compensate for sagging springs, make sure they are set to the pressure you plan on maintaining in them.)

Now, take that front measurement and find it in the top row of the chart below, then go down to the "MOTOR HOME" row to get the degree setting. This is the initial point for the CASTER setting. This chart is from the 1995 "Chevrolet Motor Home Chassis Service Guide" for the P Chassis.

Note the various vehicles in the first column that use the P Chassis. Also note that there is a separate line for the MOTOR HOME version. It is different from the "P-20, 30" line. There is a distinct possibility that an alignment shop will use the incorrect numbers if you tell them to align "my P30 chassis". But of course, we intend to TELL them the CASTER angle we want – once we go through this entire process.

INCHES	***1 1/2***	***1 3/4***	***2***	***2 1/4***	***2 1/2***	***2 3/4***	***3***	***3 1/4***	***3 1/2***	***3 3/4***	***4***	***4 1/4***	***4 1/2***	***4 3/4***	***5***
G-10, 20	3 1/2°	3 1/4°	3°	3°	2 3/4°		2 1/2°	2 1/4°	2°	2°	1 3/4°	1 1/2°			

INCHES	*1 1/2*	*1 3/4*	*2*	*2 1/4*	*2 1/2*	*2 3/4*	*3*	*3 1/4*	*3 1/2*	*3 3/4*	*4*	*4 1/4*	*4 1/2*	*4 3/4*	*5*
G-30	2 3/4°	2 1/2°	2 1/4°	2°	1 1/2°		1°	3/4°	1/2°	1/4°	0°	-1/4°			
P-20, 30			3°	2 1/2°	2 1/4°	2°	1 3/4°	1 1/2°	1 1/4°	1°	1/2°	1/2°	1/4°	0°	
CLASS A MOTOR HOME					5 1/2°	5 1/4°	5°	4 3/4°	4 1/2°	4°	3 3/4°	3 1/2°	3 1/4°	3°	3°

(32 – 52)

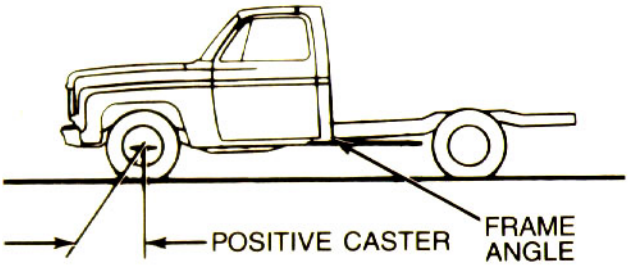
But wait! This may not be the final version of the degree setting you will use for the CASTER. The "frame angle" measurement will affect the caster setting.

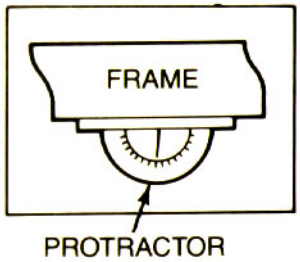
Frame Angle

OK. Here is how the frame angle is measured:

1. Park the motor home on a level surface.
2. Place a protractor with a level gage against the bottom of a straight section of the frame rail near the chassis midpoint. (See illustration below)
3. Determine the angle the frame rail slopes from level.
4. Use the previously-determined caster setting from the table above as the starting point.
5. Compute the actual caster setting from the frame angle and caster measurement taken as follows:

   (a) A **down-in-rear** frame angle must be subtracted from a **positive** caster specification.
   (b) An **up-in-rear** frame angle must be added to a **positive** caster specification. (This is the most common situation.)
   (c) A **down-in-rear** frame angle must be added to a **negative** caster specification.
   (d) An **up-in-rear** frame angle must be subtracted from a **negative** caster specification.





(You can make up the measuring tool by picking up a cheap plastic protractor, file a small notch at the 0 center on the flat side. Then capture a knotted string in that notch with a weight at the end of the string hanging down to indicate the degree of angle - not rocket science. Of course, if your eyesight is as bad as mine, get a big protractor.) Also, note that early versions of the P Chassis Service Manual had the words 'added' and 'subtracted' in a & b above reversed and c & d above reversed.

As an example, let's assume you previously measured front ride height on both sides as 4 1/2". The table says the CASTER should be set to 3 ¼ degrees. But, you then measured the frame angle and found an up-in-rear angle of 3 degrees. (b) above says you need to add that figure and you wind up with a setting of 6 ¼ degrees. That's the figure you should tell the alignment shop to use for CASTER – in this example.

If you should measure the frame angle on both sides of the motorhome and come up with one side positive angle and one side negative angle, stop and get some help. But, this would be rather extreme.

Two more settings to go for the alignment: CAMBER and TOE-IN.

Here's the table from the same 1995 manual. Note that there is no line for "P-20, 30." Interesting.

MODEL	CAMBER	TOE-IN (IN.)
G10, 20	.5°	3/16”
G30	.2°	3/16”
CLASS A MOTOR HOME (32 – 52)	.25° ± .25°	0° to .06°

Toe-in was reduced from 5/16 inch in 1985 as part of a GM trend reducing toe-in. If equipped with radial tires, some tire manufacturers would suggest toe-in specifications of 1/32 inch to 1/8 inch. Basically, you want the tires parallel, if you can't get them exactly on zero, make sure it is toward that .06 degrees and NOT toe-out.

Alignment

OK, we fixed everything we could fix and everything else is in pretty good shape with weights balanced and tires and airbags inflated correctly.

Remember: (Appendix D)

CASTER affects your vehicle's low-speed steering, high-speed stability as well as how well your vehicle drives in a straight line (on-center feel). Too little caster will cause your car to "wander" and make it feel unstable at high speeds. Too much caster causes hard steering and can also result in excessive road shock and shimmy. Caster does not affect tire wear.

The CAMBER angle is designed and adjusted per vehicle to keep the tires on the outside of a curve flat on the ground during a turn. If you have too much positive camber, your tires will wear on the outside. Too much negative camber will wear them on the inside. If there is too much of a difference between the camber settings on the front wheels, the vehicle will tend to pull sharply to one side.

TOE settings affect the handling characteristics of a vehicle in turns. Toe-in introduces Understeer going into a curve and may make the vehicle feel like the back end is trying to come around to the front end. Toe-out introduces Oversteer in a curve and makes the vehicle feel like it is "diving" into the turn too sharply. If the tires are toed-in too much, the tread will be "worn" off, starting from the outside edges. If they are toed-out, the wear will start from the inside. This type of wear is called "feathering" and can be felt by running your hands across the tread of the tire.

Seems we are ready to now tell the alignment guys in our example how we want things set. We already know the coach is level, not overweight and in good shape because we fixed everything. For our example we tell them to set CASTER for 6 ¼ degrees, CAMBER at .25 degrees plus or

minus .25 degrees and TOE-IN at 0 degrees or slightly plus up to .06 degrees.
After the wheel alignment is completed take the vehicle for a test drive. Note any wandering, drifting or pulling that would indicate that the alignment is still out-of-spec.

CONGRATULATIONS!

Your Class A motorhome should no longer be yanking on your shoulder sockets and you can enjoy the next trip a little better. You also should now have a better feel for why some maintenance needs to be done, the airbags should be consistently inflated to the same pressures and the tire pressures maintained properly. They all affect handling and safety.

The Appendices following this are for further information.

A and B help in determining if your springs are up to snuff.

C will give you the ability to interpret your VIN number.

D is basic information on the adjustable points of an alignment.

E is a couple of pages from the P Chassis manual with tire inflation information. This is generic and you should use the manufacturer's chart for your tire.

F is derived from the P Chassis manual to help you determine if you are exceeding the towing recommendation for your configuration.

Good luck,
Mike Cebula

Appendix A – Front Load Height Curve

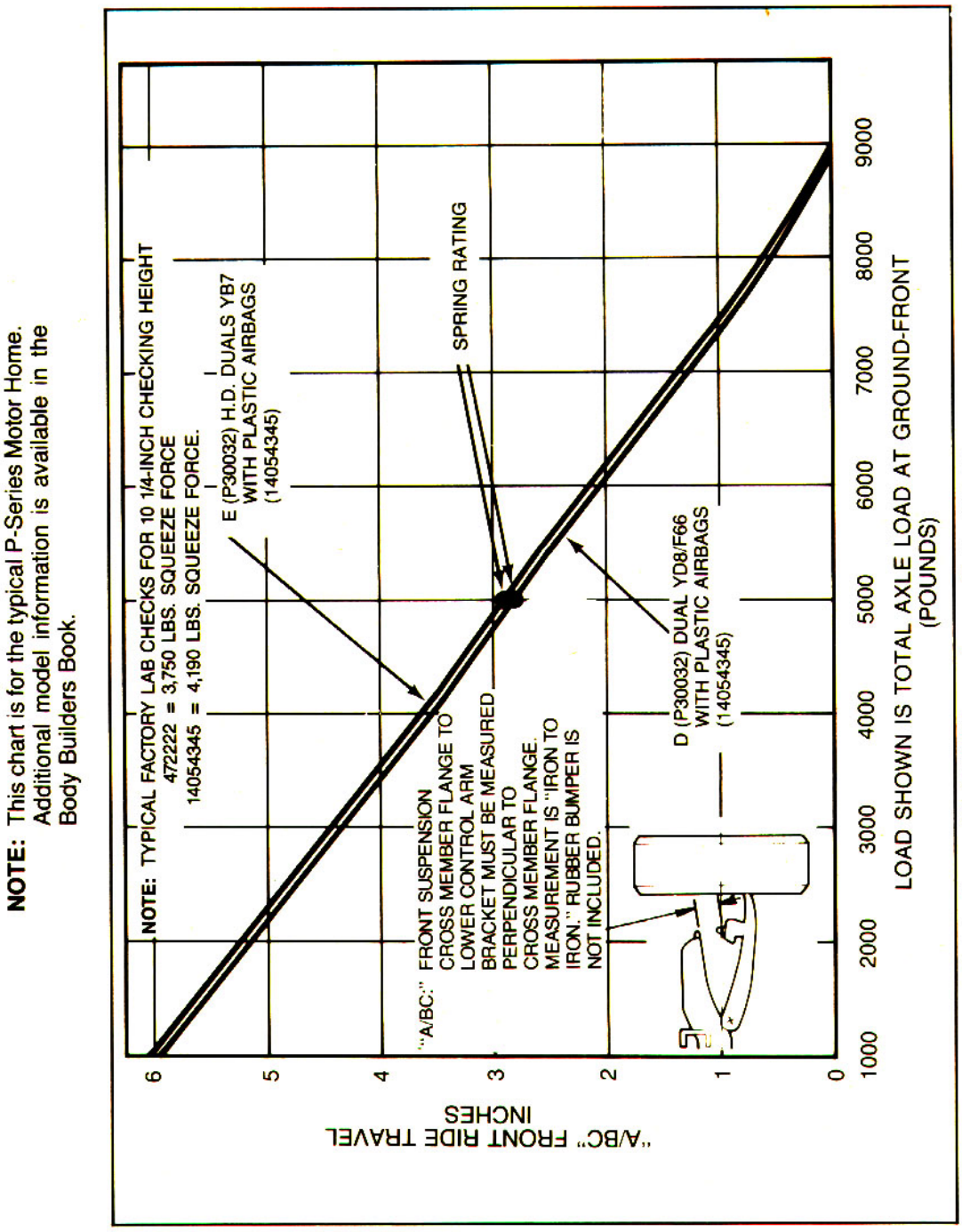
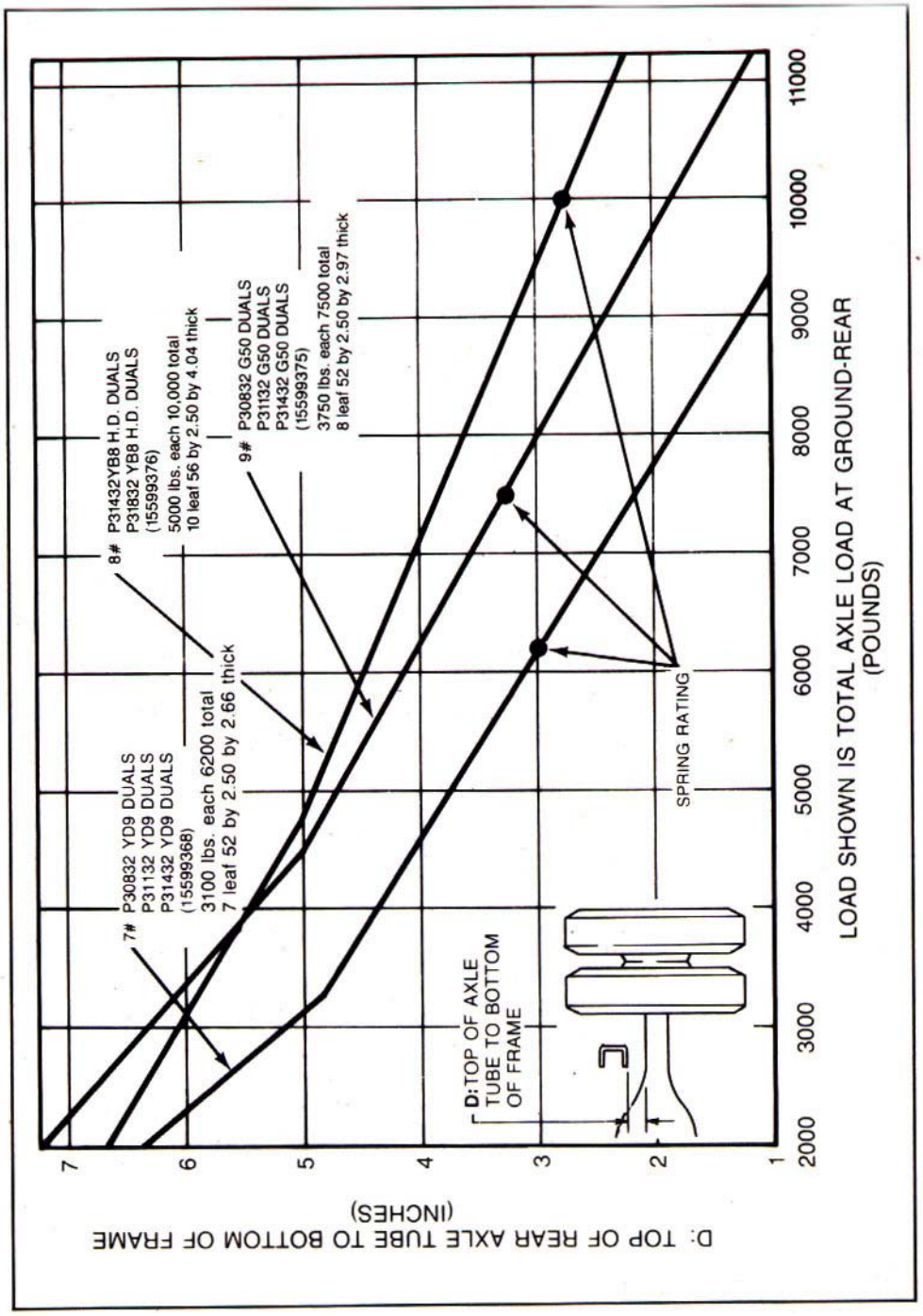


Figure A3-2-1 — Load Height Curve "A/BC" Dimension — Motor Home

Known weights compared to actual dimensions can determine if the spring is performing according to its rating. Actual measurements will be ±½-inch on the chart and normally considered within the spring makers production capability.

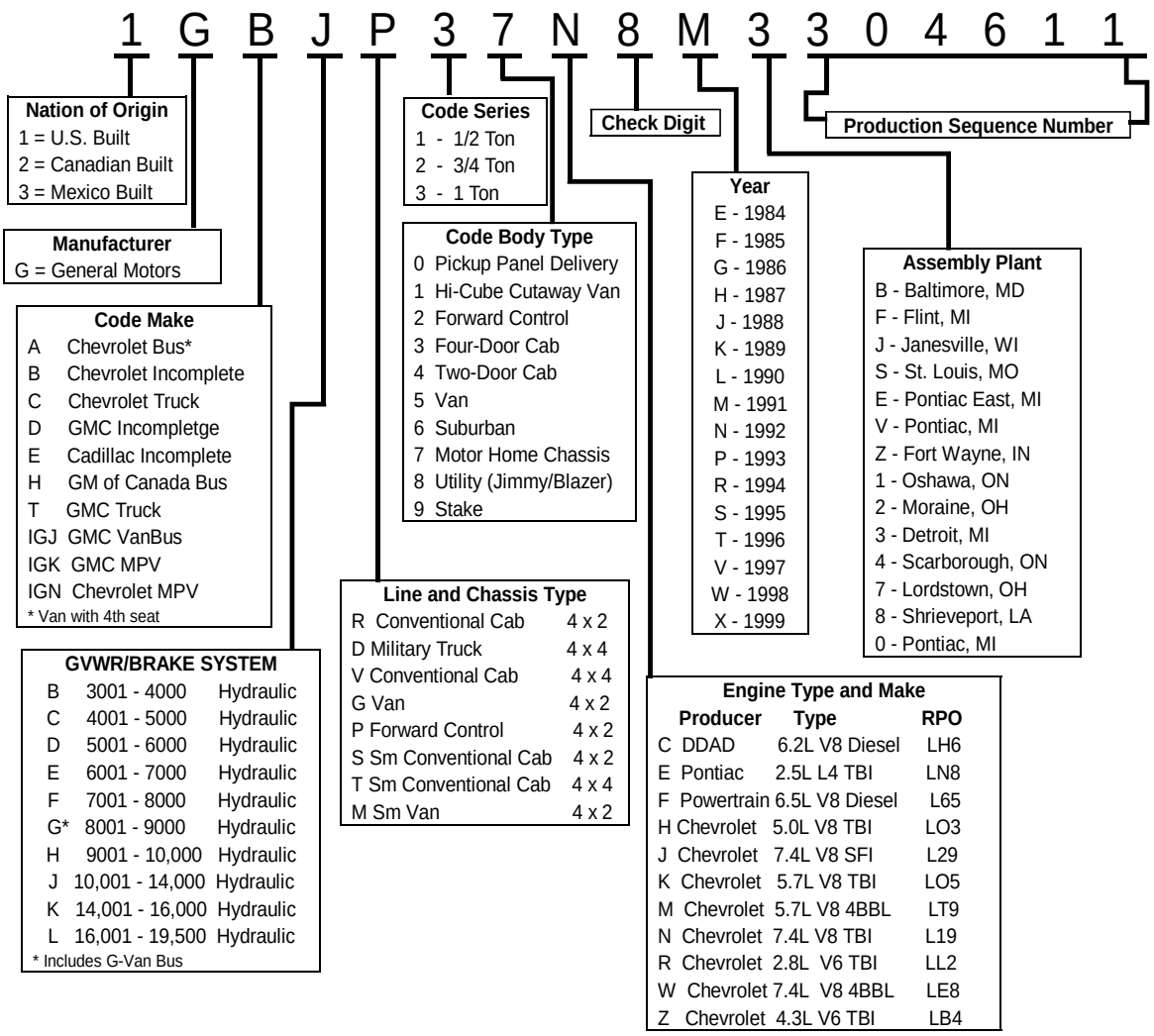
Appendix B – Rear Load Height Curve



NOTE: This chart is for the typical P-Series Motor Home. Additional model information is available in the Body Builders Book.

Figure A3-2-2 — Load Height Curve "D" Dimension — Motor Home

Appendix C – VIN



Appendix D – An Alignment Primer

SECTION 3 — STEERING, SUSPENSION, WHEELS AND TIRES

FRONT ALIGNMENT

GENERAL DESCRIPTION

The term "front alignment" refers to the angular relationships between the front wheels, the front suspension attaching parts and the ground.

The pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), are all involved in front alignment.

CASTER

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-). (See Figure 3-1.)

CAMBER

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle. (See Figure 3-1.)

TOE-IN

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to ensure parallel rolling of the front wheels. (See Figure 3-1.)

Toe-in also serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward. In other words, even when the wheels are set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. It should be noted that excessive toe-in or toe-out will cause tire wear.

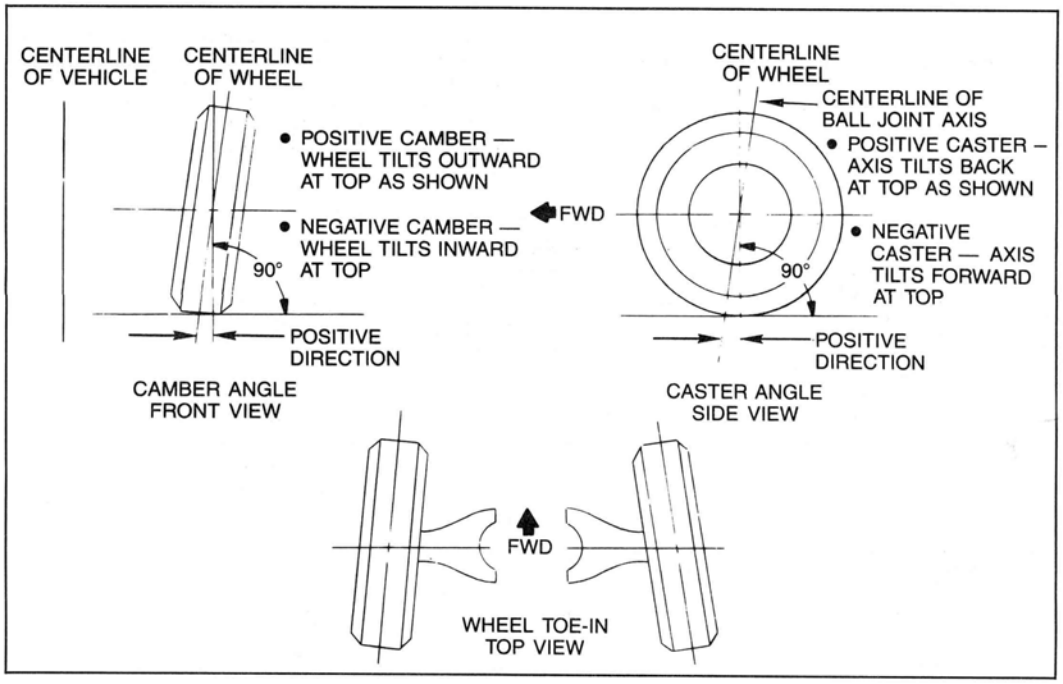


Figure 3-1 — Caster, Camber and Toe-in

3-1

Appendix E – Tire Inflation (as of 1995)

SECTION 3 — STEERING, SUSPENSION, WHEELS AND TIRES

P-SERIES

(TIRE AND WHEEL LOAD LIMITS ARE SHOWN BELOW, VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL LOAD LIMITS NOR TIRE INFLATION PRESSURE ARE EXCEEDED.)

RADIAL TIRE SIZE AND LOAD LIMITS — LBS.

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE – PSI								
			40	45	50	55	60	65	70	75	80
FRONT METRIC RADIAL TIRES USED AS SINGLES											
LT215/85R16	682	C	1640	1785	1940						
LT215/85R16	682	D	1640	1785	1940	2050	2180	2335			
LT235/85R16	653	D	1870	2030	2205	2335	2485	2623			
LT235/85R16	653	E		2030	2205		2485	2623	2765	2905	3042
REAR METRIC RADIAL TIRES USED AS DUALS											
LT215/85R16	682	C	1490	1625	1765						
LT215/85R16	682	D	1490	1625	1765	1865	1985	2150			

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI			
			55	60	65	70
FRONT METRIC RADIAL TIRES USED AS SINGLES (MICHELIN)						
8R19.5	617	D	2355	2517	2682	2800
REAR METRIC RADIAL TIRES USED AS DUALS (MICHELIN)						
8R19.5	617	D	2287	2442	2597	2700

BIAS TIRE SIZE AND LOAD LIMITS — LBS.

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI										
			30	35	40	45	50	55	60	65	70	75	80
FRONT BIAS TIRES USED AS SINGLES													
7.50-16	652	C	1620	1770	1930	2060							
7.50-16	652	D	1620	1770	1930	2060	2190	2310	2440				
7.50-16	652	E	1620	1770	1930	2060	2190	2310	2440	2560	2670	2780	
8-19.5	613	D						2270	2410	2540	2680	2800	
8-19.5	613	E						2270	2410	2540	2680	2800	2930
REAR BIAS TIRES USED AS DUALS													
7.50-16	652	C	1430	1565	1690	1815							
7.50-16	652	D	1430	1565	1690	1815	1930	2040	2140				
7.50-16	652	E	1430	1565	1690	1815	1930	2040	2140	2245	2345	2440	
8-19.5	613	D						2230	2350	2460			
8-19.5	613	E						2230	2350	2460	2570	2680	2780

WHEEL CODE AND LIMITS

CODE	WHEEL SIZE	MAX. LOAD LBS.	MAX. PRESSURE PSI
AF or AR	16x6K	2440	80

CODE	WHEEL SIZE	MAX. LOAD LBS.	MAX. PRESSURE PSI
ZY	19.5x6	2540	80
ZT	19.5x6	2780	95

Figure 3-17 — Tire/Wheel Load and Inflation Pressure Charts (Continued) See Owners Manual

3-15

RADIAL TIRES USED AS SINGLES

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI						
			35	40	45	50	55	60	65
7.50R16	654	D	1620	1770	1930	2060	2190	2310	2440
DUAL									
7.50R16	654	D	1430	1565	1690	1815	1930	2040	2140

MICHELIN **SINGLES**

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI						
			55	60	65	70	75	80	85
225/70R19.5	646	F	2475	2650	2835	3040	3220	3405	3640
DUAL									
225/70R19.5	646	F	2377	2557	2755	2862	2970	3185	3415

Two wheels are used on the assembly line that turns out the GM P-32 motorhome chassis. Chassis with gross vehicle weight ratings (GVWR) of 10,500 pounds to 12,300 pounds use a 19.5 x 6, 8-hole wheel with a 6.5-inch bolt circle — part number 15963341. Chassis with a GVWR of 14,500 pounds to 16,500 pounds use a 19.5 x 6, 10-hole wheel with a 7.25-inch bolt circle — part number 14005758.

Appendix F – Towing

The GCWR (Gross Combination Weight Rating) includes weight of both the motorhome and anything being towed.

Only the V8 and diesel models are shown here. The combination of engine and rear axle ratios are the determining factor for the GCWR on the P Chassis.

GCWR	***10,000***	***10,500***	***11,000***	***11,500***	***12,000***	***12,500***	***13,500***	***14,000***	***14,500***	***15,000***	***16,000***	***19,000***
ENGINES	REAR AXLE RATIOS											
5.7L (350) V8 GAS	3.08	3.23	3.42		3.73		4.10			4.56		
6.2L V8 DIESEL	3.42		3.73		4.10		4.56	5.13*				
7.4L (454) V8 GAS						3.21	3.42		3.73		4.10	4.56 4.88*

*Motorhome chassis only.

NOTE:

GCWR for unit with 4L80E transmission is 21,000# with GVWR of 16,500#.
For GVWRs less than 16,000#, the maximum GCWR is 19,000#.
Max GCWR with the 475 transmission is 19,000# for all GVWRs (1990 & before).

CAUTION: Adequate size brakes are required on towed vehicle/trailers over 1,000 of loaded weight.

If our 11,800 lb. GVWR example motorhome is equipped with a 454 and a 4.88 rear axle, we should be able to safely tow something that is up to 7,200 lbs. WOW! Of course, we would equip it with remote brakes because those hills seem to get higher as both the motorhome and we age. Also, the law in some states says you need remote brakes on anything over 1,000 lbs. Installing a hitch rated at 10,000 lbs just says the hitch is safe at that towed weight. Not necessarily the motorhome. Be safe.

How do I determine my rear axle ratio?

The actual ratio should be stamped into the axle housing. It will usually be found on the forward portion of the axle tube on the right side. Probably pretty gummed up and difficult to read too.

The stamping on the housing is read as follows:

First 3 digits indicate the rear axle ratio. (you can stop right here)
Next digit indicates the build source C=Buffalo, K=Canada
Next 3 digits indicates the day built - expressed in Julian Date form
Last digit indicates the shift 1=1st shift, 2=2nd shift. (Don't have any idea what the purpose of this is.)

Another way is to try and find the RPO codes sticker somewhere in the coach, your Chevy dealer can interpret it for you. The RPO info I have is:

RPO 066 is 4.10
RPO 005 is 4.56

Don't have info for the 4.88 or any others.

Those are the easy ways.

The hard way is a little more difficult with a motorhome than with a car, but is absolutely the most accurate - here goes:

Raise the rear axle off the ground, support, support, chock front wheels and then support some more to make sure it is safe. Transmission should be in neutral and emergency brake off (chocks - remember?). You are going to be UNDER this thing.

Make a BIG chalk mark on one side of the driveshaft that can be seen from alongside the vehicle (you don't really want to be under it very long for this). Make a corresponding mark on the side of the housing that aligns with the driveshaft mark, on the pinion housing would be good.

Now make a mark on the right rear tire either exactly at the top or exactly at the bottom. Maybe make a corresponding chalk mark on the fender for alignment purposes. The objective is to SLOWLY rotate that tire one complete revolution while someone watches the drive shaft chalk marks and counts the revolutions.

The number of turns the driveshaft makes indicates the ratio. In other words, 4 complete revolutions and almost another full one is probably a 4.88.

Appendix G – Chart for properly matching tires to rims/wheels.

Information obtained from the 1994 Tire and Rim Association Yearbook.

TIRE SIZE (1)	APPROVED RIM CONTOURS (2)
	LIGHT TRUCKS
6.50 16LT	4½K, 4.50E, 5K, 6K, 6L
7.50 16LT	5.50F (SDC), 6K, 6L, 6½L, 7L
LT225/75 16	6J, 6½J, 6K, 6½K, 6½L, 7J, 7K, 7L
LT245/75 16	6½J, 6½K, 6½L, 7J, 7K, 7L
LT265/75 16	7J, 7K, 7L, 8J, 8L
LT285/75 16	8J, 8L, 8LB, 8KB
LT215/85 16	5½J, 5½K, 5.50F (SDC), 6J, 6K, 6½J, 6½L, 7J, 7K, 7L
LT235/85 16	6J, 6K, 6L, 6½J, 6½L, 7J, 7K, 7L
LT255/85 16	6½J, 6½L, 7KB, 7J, 7K, 7L, 8J, 8KB, 8L, 8LB
LT235/70 16	6J, 6K, 6L, 6½J, 6½K, 6½L, 7J, 7K, 7KB, 7L, 7½J
LT255/70 16	6½J, 6½K, 6½L, 7J, 7K, 7KB, 7L, 7½J, 8J, 8KB, 8L, 8LB, 8½J
LT275/70 16	7J, 7K, 7KB, 7L, 71⁄2J, 8J, 8KB, 8L, 8LB, 81⁄2J, 9J
8.00 16.5	6.00, 6.75
8.75 16.5	6.00, 6.75
9.50 16.5	6.75, 8.25
8 19.5	5.25, 6.00, 6.00RW, 6.75
225/70R 19.5	6.00, 6.00RW, 6.75, 6.75RW
245/70R 19.5	6.75, 6.75RW, 7.50, 7.50RW
265/70R 19.5	7.50, 7.50RW, 8.25, 8.25RW
305/70R 19.5	8.25, 8.25RW, 9.00

A " denotes both Radial and Bias tires.
An 'R' indicates Radial tires only.

Good reference sites for info:
http://www.trucktires.com/us_eng/technical/index.asp
http://www.accuridewheels.com/
http://www.us-tra.org/ (not much of a safety-minded organization since they SELL their info)

Weights Worksheet

From Plate: GAWR FRONT	Actuals: Left Front	Right Front	Total
_____	_____	_____	_____
GAWR REAR	Left Rear	Right Rear	Total
_____	_____	_____	_____
	Tag Left Rear	Tag Right Rear	Total
TOTAL GAWR	_____	_____	_____
_____	_____Total Actual Weight		

Brakes
Capability
Max Weight
(digit 4 of VIN)

_____ VIN # _____

GCWR
Capability
(Appendix F)

_____